

one cell-generation to another, thus establishing for the nucleus beyond all question of doubt the rank of morphological unity. The classic and path-breaking work, "Ueber Zellbildung und Zelltheilung," reached the third edition in 1880, while its author was professor at Jena.

Since going to Bonn, Prof. Strasburger's more important contributions, dealing chiefly with the division of the nucleus and of the cell, with the growth of the cell-wall, the structure of the vascular bundle, and with the process of fecundation, have appeared in five or six volumes, each bearing the principal title "Histologische Beiträge." The bulkiest of these volumes (No. 3), and probably one of the most noteworthy, is on the structure of the vascular bundle ("Ueber Bau und die Verrichtungen der Leitungsbahnen in der Pflanzen"). Apart from several other very important monographs, Prof. Strasburger has prepared the best and one of the most elaborate laboratory manuals and handbooks of microscopic technique known to biological science. "Das botanische Practicum" is now in its fourth edition. "Das kleine botanische Practicum," an abridged edition for the use of more elementary students, was also prepared. A translation of this volume by Hillhouse is still one of the very best botanical handbooks in the English language. With the aid of his former collaborators, the late Prof. A. F. W. Schimper, Prof. Fritz Noll, now of the University of Halle, and Prof. Heinrich Schenck, of the Technical University of Darmstadt, the text-book of botany was prepared, which has gone through several editions and has been translated into several languages.

In more recent years the results of certain important investigations carried on in the institute have been published conjointly by Prof. Strasburger and his students. The most important of these is the volume known as the "Cytologische Studien," which marked the beginning of the more modern phases of cytology. The especial value of this collection of papers consists (1) in the perfection of the best cytological methods known at present for a number of widely differing plants, (2) in the proof that no such structures as centrosomes or centrospheres exist in higher plants, and (3) in the complete establishment of true sexuality in the ascomycetes. Occasionally, Prof. Strasburger carries his private work into fields somewhat removed from the general subject of his life work, though such studies have been comparatively few. In this connection may be mentioned the elaborate study with dioecious plants, having for its object to determine, if possible, the effect of environmental conditions upon the control of sex. During the past few years the chief work of the institute has centred about problems relating to the physical basis of heredity, such as the individuality of the chromosomes, the transmission of characters in hybrids, &c.

A glance at the vast amount of literature issued from this most famous centre of cytological research is sufficient to convince one who is not a special student of cytology that the main object and life-work of its director is to understand the meaning of the cell by knowing in the most detailed manner its structure at every step of its activity in all kinds of plants, from the lowest to the highest, and that which has been discovered is only a fair index of what is still to be known.

Probably a summary of the day's programme at the institute will not be without interest to the reader. During the winter semester Prof. Strasburger lectures upon the morphology of the plant groups below the spermatophyta, four lectures being given per week. Once a week, on Fridays, the public lecture is given, which is open to all who wish to attend.

The subject of these public lectures varies from year to year, but it usually pertains to some topic of general interest concerning plants, and is treated from a philosophical standpoint. In the summer semester the lectures deal with the anatomy and physiology of the higher plants. Before going to the lecture room, the professor makes his daily rounds in the advanced laboratories, visiting each investigator, making inquiries concerning the progress made during the past twenty-four or forty-eight hours, and at the same time offering suggestions and criticisms. A visit is frequently made to the laboratory after the lecture or in the afternoon, depending upon the interest in the particular line of study.

Prof. Strasburger's wonderful grasp of the whole field of morphology and physiology, as brought out in frequent discussions in the laboratory, increases daily one's admiration and quickens in one the consciousness of being in the presence of a master mind. When the marvellous results of this centre of scientific research are considered, and the relatively meagre equipment and lack of convenience, the success can only be attributed to the genius of the man who is the centre of its activity and the source of its inspiration.

D. M. MOTTIER.

#### EXAMINATION v. RESEARCH.

A UNIVERSITY is as much a place for compromise as a party caucus or a church. It has to provide for different needs and to satisfy conflicting interests. It has to preserve its corporate balance against the attacks of specialists and extremists who try to drag it on to a side-track. And it has to do all these things with limited means and limited wisdom. From time to time doubts may well arise as to how far it succeeds in steering the best course. Oxford at present is in the throes of such a discussion. Always critical, she is more critical of herself than of anything less near and dear, and is now enjoying a perfect orgie of self-criticism. But such emotional delights should not lead to oblivion of the fundamental facts of academic life.

Oxford has to find a working compromise between four distinct functions which lead up to four distinct ideals (or exaggerations) of a university. She has to educate, to teach, to examine, and to research, to say nothing of governing herself, which is not, perhaps, the supreme ideal, as our officials are apt to imagine.

(1) Educationally, Oxford is a place where those who can afford it, or are selected by private or public charity as fit recipients of scholarships, may obtain an intellectual training which will fit them (more or less imperfectly) for a number of professional pursuits, and are subjected to a moral discipline which (again somewhat imperfectly) induces them to do less harm to themselves and to create less disturbance in the community than similarly situated youths are wont to do in any other country. Thus Oxford is not an ideal university. But it is as incapable of being the university of Bohemia as of Utopia. Its educational ideal conducts to the perfect gentleman, or, if it fails, to the perfect snob.

(2) As a teaching institution Oxford is expensive, but (on the whole) efficient. It is expensive because it sacrifices the teacher to the taught, and leads the former to bestow upon the latter a great deal of individual attention, more, possibly, than is good for him, more, certainly, than is necessary or than he gets elsewhere. It is efficient because the college spirit is strong, and the competition between the colleges is keen. Wherever this inducement fails, *i.e.* wherever the university conducts the instruction or the college takes no pride in it (*e.g.* in the case of

the "pass" man), the tutor has *not* rendered the "coach" superfluous. Elsewhere the teaching is good of its kind. But since good teaching aims at enabling every fool to appear a genius, it is not an end in itself. The teacher's ideal therefore has to be controlled by a higher, the *examiner's*.

(3) These two functions are quite distinct. The good examiner is not necessarily a good teacher, nor *vice versa*. The excellence of the teacher lies in his ability to instil knowledge and a desire for knowledge; that of the examiner is held to be the exposing of ignorance and pretence. Experience has shown, also, that competitive examinations are among those aids to learning which appeal most forcibly to the national character. They appeal strongly also to the critical faculties of the academic man, and to the love of power in a class which has naturally few occasions for gratifying this instinct. It has been discovered that though knowledge is power, yet the power of testing knowledge confers *superior* power. It is possible to control all knowledge by conducting examinations in it. This, therefore, is what we have set ourselves to do, and the regular genesis of a new branch of study is, first an examination, then students, and last of all the provision of teachers. This is distinctly suggestive of Looking-Glass Land, but to one who has grasped the rationale of examinations it will not be the paradox it seems.

Now it need not be wholly denied that examination has its uses. A certain amount thereof is necessary, and even beneficial to the soul of the examinee, promoting in him a willingness and capacity to absorb and reproduce teaching and to arrange his knowledge which are very conducive to mental efficiency. But the qualities which examination fosters and rewards are not the only qualities of value. Moreover, the benefits to the soul of the examinee are offset by grave dangers to that of his examiner; for the ideal examiner becomes one who is wholly devoted to the exercise of his function, and wholly critical. He can examine everything but produce nothing.

When, therefore, for these and other reasons which it would hardly be decorous to mention, a university sets up an examination system, and gives it power over the whole realm of knowledge, it runs a risk of sacrificing to this idol all its other functions. Teachers and taught alike are sacrificed to it at the annual holocausts, the results of which are contemplated with such reverence that their fame clings to their victims throughout life, and forms an important factor in their subsequent success or failure. Hence it is an ingenuous refinement of cruelty when professors of eugenics argue statistically that there is a "high degree of correlation" between success in examination and in life. Does it not follow rather that when a university conceives too great an admiration for its examinational function, it will grow a mental atmosphere which affects the national mind, and is deadly to all its other ideals? The "perfect gentleman" and the devotee of culture (mental or physical) will be forced by the menace of examination into undignified and banal efforts to escape expulsion. The ideal of the perfect researcher will hardly be allowed to germinate for such a university will have as little use and real regard for researchers as for "pass" men.

(4) Yet the Laputan ideal of an academic life of pure contemplation (or, in a more modern but lowered version, of scientific productiveness), exempt from the sordid duties of disciplining, teaching and examining, is in some ways the prettiest dream of them all. It is a sad pity that ever since the days of Dean Swift mankind has laughed at it. For there is some good in the researcher's ideal, even though

in its extreme form it is absurd. In practice *no* seat of learning can be made up of professors who do not teach, and exist only as objects of distant contemplation by students fearful of perturbing their sacred meditations. Neither the country, nor our purses, nor our sense of humour, would stand it. Besides, it is a psychological fact that a certain amount of teaching is good for research, just as a certain amount of research is good for teaching. The one helps to clarify the worker's exposition, just as the other helps to imbue the teacher with a flavour of originality. Whether a similar connection could be traced between researching and examining seems more disputable.

But there can be no doubt that at present Oxford sets too low a value on research because it sets far too high a value on examination. This sterilises research both by the excessive selection of minds possessing the excellences of the examinee without possessing those of the real student or of the scientific originator, and by the enormous absorption of time and mental energy which our vast masses of examining exact. The wonder is that with such a system we produce anything at all. It is a still greater wonder that, despite contrary assertions based on our habits of self-depreciation, our scientific output, taking it all in all, is not inferior in quality or even in quantity to that of any other academic institution in the world. The explanation lies in the excellence of our recruiting system. We make ourselves so attractive that even the ablest will welcome an opportunity of joining our ranks. And then the perversity of human idiosyncrasy will divert some of this surplus ability into researches which we tolerate without encouraging. For genius, like murder, will out. But with the high average of ability we have in Oxford we could, and should, produce much more, if only more value were put upon productiveness and less store set by criticism.

Enough has been said, perhaps, to give an idea of the root of the evil. But it is not so easy to suggest remedies; for radical measures are Utopian, and ignore the psychological hold which the examination-system has over the national character. But the following suggestions at least seem wholly practicable. (1) In some subjects, *e.g.* natural science (but not, perhaps, in classics, mathematics, and philosophy), the lead just given by the modern historians might be followed, and a research thesis be permitted to form part of the undergraduate's examination. (2) Most of the university prizes, &c., should be awarded to the best researcher rather than to the best examinee. (3) There ought to be a great development of graduate study, and our teachers ought to be enabled, and even required, to acquire a greater initial superiority in knowledge over the taught than is compatible with a system under which most of them are appointed immediately after examination. It will be a red-letter day when an Oxford college elects a research student pure and simple, a mere B.Sc. or B.Litt., to a fellowship. (4) Fellowship examinations of the sort we now have ought to be abolished; for what is the use of deciding over again whether a man possesses the qualities of a good examinee? A college should ascertain rather whether he possesses also the capacity of working at his subject. And, as we saw, he is not the less likely to make a good teacher on this account. From this point of view it is to be hoped that our new Chancellor will give us at least an object-lesson in self-reform by inducing an alteration in the All Souls fellowship examination. (5) The university and the colleges should largely increase the inducements to their members to proceed to "superior degrees" and to undertake the researches which a doctorate ought to imply. At

present only the "new" doctorates of Science and Letters connote any considerable intellectual achievement (though they all mean much spare cash), and so they are manufactured chiefly for export, and hardly half-a-dozen of the existing college tutors (of whom the present writer was unwise enough to become one) have found it desirable to take them.

There are, I know, difficulties of detail in the way even of these moderate suggestions; but even their partial and gradual adoption would abate the fascination of our examination system, and check the tendency to identify the good examinee, functioning as a good examiner, with the ideal of academic man.

F. C. S. SCHILLER.

#### PROF. C. A. YOUNG.

FEW astronomical books have acquired or have deserved a wider reputation than has been accorded to the "General Astronomy" of Prof. C. A. Young, and all who have profited by the accuracy and completeness of that work will regret to hear of the death of the distinguished author, who identified himself so closely with the progress of the Princeton Observatory (N.J.). Other popular works, such as "The Sun," have been well received, for Prof. Young's qualities as a writer and teacher were well known and acknowledged. But though accident may have given him distinction as a writer of elementary works, of which his long career as a teacher had shown him the necessity, he had far greater claims on our respect and gratitude. Son of a distinguished astronomer, Dr. Ira Young, of Dartmouth, he was early and severely trained in mathematics and astronomy, and for fifty years he gave of his best to forward the interests of the science he loved. Moreover, his activity synchronised with the recent development of physical astronomy; he was one of the pioneers of solar spectroscopy, and his continued and successful researches in various directions entitle him to ample recognition.

His first appointment was to the chair of mathematics in the Western Reserve College, a post from which he retired only to serve his country in a military capacity during the War of Secession. After the war, he succeeded his father as professor of astronomy at Dartmouth College, leaving that post in 1877 to accept a similar position at Princeton, where his energies found sufficient exercise during the remainder of his professional career.

Like most astronomers who have occupied themselves with solar phenomena, Prof. Young found it necessary to follow the track of many eclipses. The most famous of these is that of 1870, when he, for the first time, saw and described the now familiar appearance of the reversed Fraunhofer lines at the instant of the inner contact of the limbs of the sun and moon. Owing to the much-debated "reversing layer," which he suggested as the true cause of the flash, this eclipse has become historical. He took part in the observations of the solar eclipse of 1878 which passed over the American continent, and visited Europe in 1887 for the Russian eclipse, but without result, owing to bad weather. Onwards to 1900 he was a diligent observer of eclipses, and extended our knowledge of the sun's surroundings as well by his acute observation as by his luminous discussion of results obtained. His early explanation of the spectrum of the corona is now received practically as he gave it.

But Prof. Young's researches were not limited to exceptional opportunities. He gave constant and assiduous attention to the solar spectrum at all times, and was an indefatigable observer of the spectrum of

sun-spots, repairing to favourable situations in order to secure good observing conditions. The chromosphere, no less than sun-spots, was the subject of his care, and his catalogue of chromospheric lines, begun so far back as 1872, is a memorable piece of work. Further, he was among the first to determine the velocity of the solar rotation at various heliographic latitudes by measuring the displacement of solar lines due to motion at the source of light. The spectra of planets and comets, of stars and nebulae, were all made the subject of profound study, for his industry was as untiring as his resource was abundant. His work was recognised by the Royal Astronomical Society, which enrolled him among its associates in 1872, and many other learned societies paid him similar honours. He was the recipient of the Janssen medal of the French Academy of Sciences in 1891, but his great reward must have been the consciousness of the amount and variety of work he had accomplished for the promotion of astronomical science.

#### NOTES.

WE regret to announce that Prof. J. B. Pettigrew, F.R.S., Chandos professor of medicine and anatomy in the University of St. Andrews, died on January 29 in his seventy-third year.

WE observe with great regret the announcement that Mr. W. A. Shenstone, F.R.S., senior science master in Clifton College since 1880, died on Monday, February 3, at fifty-eight years of age.

A REUTER message from Brussels announces the death of M. A. Lancaster, director of the meteorological department of the Royal Observatory of Belgium at Uccle.

PROF. W. RIDGEWAY, professor of archaeology in the University of Cambridge, has been elected president of the Royal Anthropological Institute.

THE French Physical Society has undertaken the publication of a collection of physical constants. The general secretary, M. H. Abraham, has issued an appeal to members of the society to assist in the collaboration.

THE King, who is patron of the Society of Arts, has granted permission to the society to prefix to its title the term "Royal," and the society will consequently in future be known as the "Royal Society of Arts."

ON Tuesday next, February 11, Prof. Stirling will begin a course of six lectures at the Royal Institution on "Membranes: their Structure, Uses, and Products." The Friday evening discourse on February 14 will be delivered by Dr. C. W. Saleeby on "Biology and History," and on February 21 by Sir Oliver Lodge on "The Ether of Space."

SIR PHILIP WATTS, K.C.B., F.R.S., Director of Naval Construction, has been elected a member of the Athenæum Club under the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

THE annual general meeting of the Iron and Steel Institute will be held on Thursday and Friday, May 14 and 15. The annual dinner will be held—under the presidency of Sir Hugh Bell, Bart.—in the Grand Hall of the Hotel Cecil on Thursday, May 14. The autumn meeting will be held in Middlesbrough on September 29 and following days.